

SUNMASTER QS SERIES
GRID CONNECTED SOLAR INVERTERS

MASTERVOLT

SOLAR INVERTER

Foto: J. Döppeler

Sunmaster QS Series

Mastervolt Solar is proud to present the brand new Sunmaster QS grid connected inverter series.

The Sunmaster QS series consists of four products, the Sunmaster QS1200, QS2000, QS3200 and QS5000, providing reliable and flexible solutions for PV systems ranging from 700 to 5000Wp. Key points in the design are reliability and quality, easy installation and full compliance with the most stringent international norms. Due to the advanced High Frequent technology, the QS inverters are efficient, lightweight and compact. The wide input window and 'multiple MPPT inputs' allow a wide variety of system designs.

Wide input range

The Sunmaster QS Series is designed as a full series. Together the four models provide solutions for system sizes between 700 and 5000Wp:

- Sunmaster QS1200: 700-1200Wp
- Sunmaster QS2000: 1200-2000Wp
- Sunmaster QS3200: 2000-3400Wp
- Sunmaster QS5000: 3400-5000Wp

The input window of the Sunmaster QS inverters is wide, allowing the connection of a large variety and number of both crystalline and amorphous modules.

Multiple inputs with individual MPPTtrackers

The Sunmaster QS3200 and QS5000 are equipped with 2 and 3 separate inputs respectively. Every DC input has its individual MPPTtracker. This facilitates the connection of strings with a different number



of modules in series, different orientations or different module types to a single QS inverter. This feature greatly enlarges the flexibility in PV array configurations: for every situation there is a solution.

Easy installation

Installation of the Sunmaster QS inverters is easy and fast. The QS inverter can be connected using either connectors (Multi Contact connectors for the solar side or euro plug for the grid side) or glands, just as you prefer it. Connection of the cabling is easy, because of the easily accessible connection compartment on the front side of the inverter. The compact size and low weight make the mounting of the inverter an easy job.

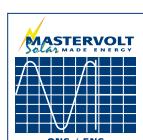
connection compartment on the front side of the inverter. The compact size and low weight make the mounting of the inverter an easy job.

Safe and reliable lasting operation

The Sunmaster QS power concept is based on state of the art High Frequent technology, ensuring high efficiency, compact size and low weight. Part of the power conversion is the HF Class II safety transformer, that ensures the Class II galvanic separation between solar and grid side.



*Easy installation:
plugs or glands,
just as you prefer it
(QS1200/2000).*



The QS Series is equipped with the QNS anti-islanding device. This device ensures redundant measurement and switch off of the inverter in case of a grid failure. The QNS device is based on measurement of the grid voltage and frequency and complies with all relevant standards. Additionally, the QS inverters can be supplied with a VDE0126 compliant ENS unit, that adds the measurement of the grid impedance. The solar side of the system is protected by earth fault detection for installation faults and thermally guarded varistors for lightning induced voltages.



Bi-functional LED bar in power mode (left) and fault diagnosis mode (right).

Standard: bi-functional LED bar

All Sunmaster QS inverters are equipped with a bi-functional LED bar, integrated in the front cover of the unit. The LED bar indicates the amount of converted power during normal operation and the self diagnosis results during system faults or start-up. This ensures that the operation of the PV system can be monitored continuously without any extra devices. In case of system errors, the clear indication gives the user information, which can be passed on to the service provider.



types, can be connected to one inverter, without loss of yield. Conclusion: the QS series offers optimal design flexibility. To guide you through all design options,



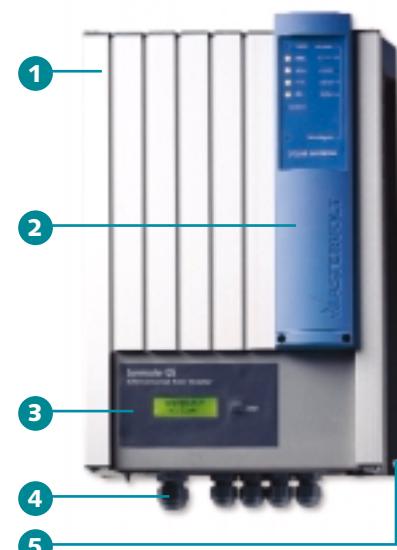
Integrated QS Display connected to the QS Data Bus.

ble, it is possible and easy to connect as well. You are able to connect any type of device in any arbitrary combination in a straight forward way. From a simple local read-out of a single inverter by PC to an extensive system with multiple inverters, wireless displays, data monitoring and remote control: both are easily designed, configured and connected. Central to the concept is the *QS Data Bus* with the QS Multi-Master protocol, enabling bus wise connection of all devices and automatic configuration of all hardware and communication settings. For further information, please refer to page 6 & 7.

Designing your system

With the QS Series, Mastervolt Solar provides an optimal inverter solution for any system configuration you might need. The wide input window, full range (700-5000 Wp) and features such as the multiple inputs with individual MPPT trackers, gives the designer the freedom he needs to design virtually any kind of system. Systems with several orientations or inclinations, or

Mastervolt Solar offers a *PV Design Wizard*, that will be available at our website at the end of 2001. The only thing you have to do, is to select your module type and enter the desired number (or range) of modules you want to use in your system: the *PV Design Wizard* will tell you which inverter to use and how to connect it. Refer to page 13 for more details of the design of a system using the QS products.



Sunmaster QS1200 in compact lightweight enclosure.

Key:

1. Compact lightweight enclosure. Industrial design.
2. Clear LED bar with power indication and fault diagnosis.
3. Removable front panel for easy access to the connection compartment. Front panel can be replaced by the optional QS Display (as shown).
4. Equipped with glands as a standard. With DC Multi Contact and AC Europlug connectors available too.
5. Simple mounting, without opening the inverter.

QS Data Monitoring and Control

The intuitive approach: when you think it is possible, it is.

Part of the family of QS products is an extensive program of communication, display and monitoring facilities. The central philosophy is that you literally should be able to play with the possibilities: when you think a certain configuration is possi-

What you can find in this Sunmaster QS brochure

The concept	2-3
The family of products	4-5
Control and monitoring products	6-7
Technology	8-9
Product design, production and quality	10-11
Product specifications	12-13
Delivery program and availability	14-15

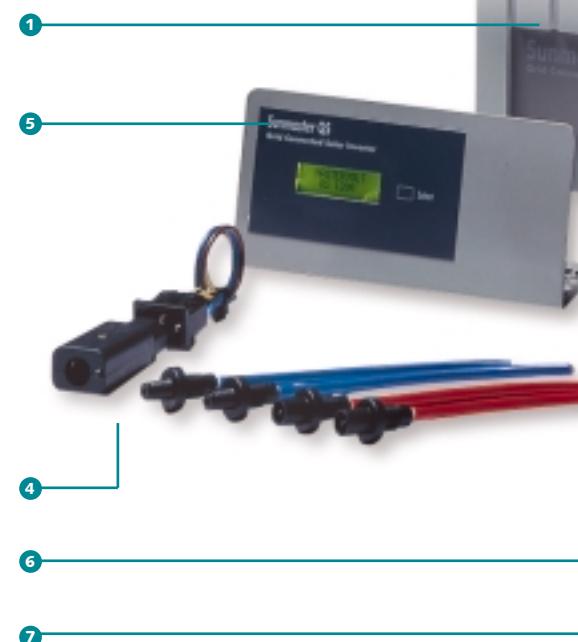
Sunmaster QS Series: a product family

With the Sunmaster QS Series Mastervolt offers you a full range of products, with which you can freely and intuitively design any PV system. When you know how to design, install and communicate with one Sunmaster QS, you will know how to work with the whole range. Input specifications are more or less equal for each inverter; the bigger units just have more of the same inputs. Dimensioning per input stays the same: if you know how to do it for one PV system, you will know it for every system size (refer to page 13). The range of communication options works together in an intuitive and straight forward way, and can be combined with any set of Sunmaster QS inverters: communication options for the QS1200 are the same as the ones for the QS5000. Connection material, installation and commissioning is the same for all units.

1 The Sunmaster QS has a compact, light weight enclosure. Mounting is simple, since the mounting brackets are on the outside of the cabinet. The backside of the cabinet leaves enough room to feed any cabling you need from the top side of the inverter to the bottom side. The connection compartment is situated on the front side of the inverter, giving access to the solar and grid connections, the connections for communication and the lightning varistors. The front panel can easily be removed by loosening two screws. The front panel can be replaced by a version with the integrated QS Display. The cabinet is constructed from folded

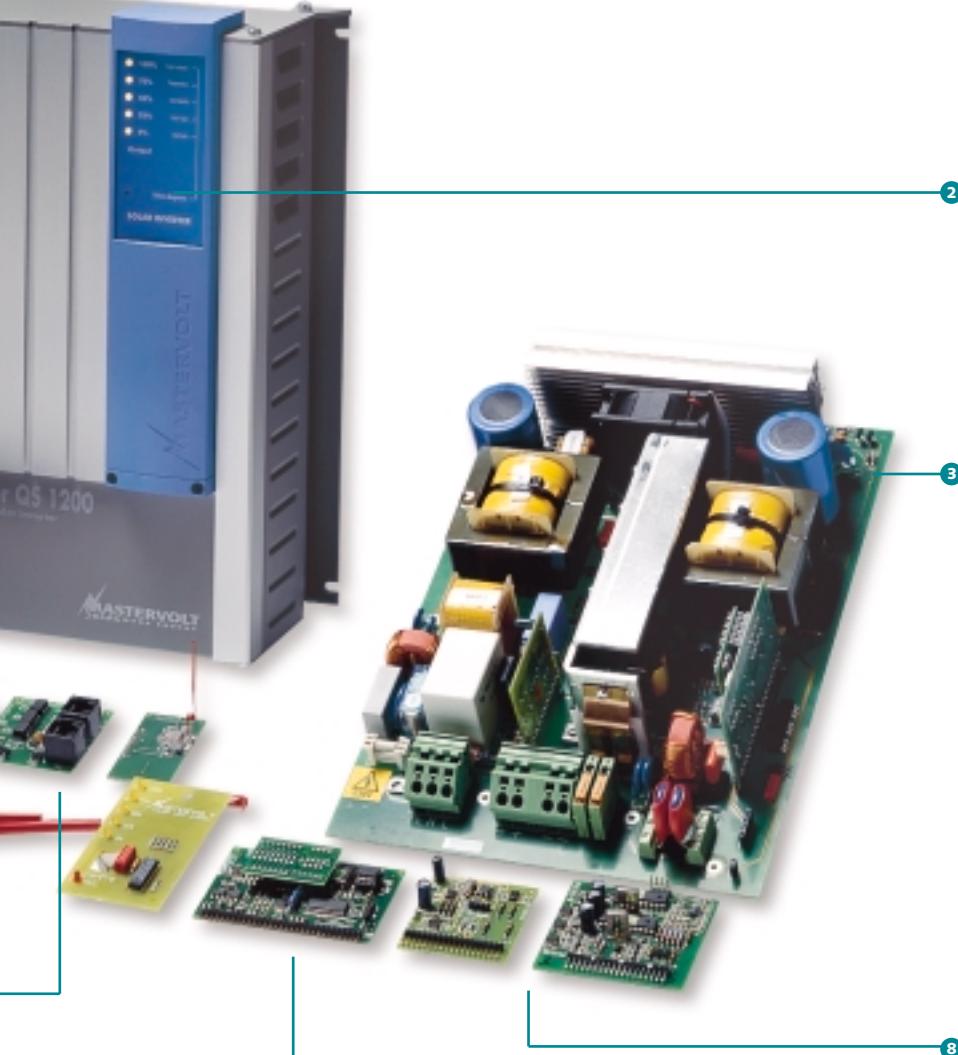
and powder coated metal combined with aluminium extrusion profiles, resulting in a strong design, with an attractive appearance.

2 Standard for all Sunmaster QS inverters is the integrated LED bar with 6 LEDs. The LED bar indicates the amount of converted power and the results of the self diagnostics of the



inverter during start-up and fault situations. The LED bar provides the user the basic information he needs to assess whether his system is working correctly.

3 The Sunmaster QS inverters use high frequent technology with small HF Class II transformers for the galvanic separation. The result is a compact, light weight power conversion design on a single power board. The advantages of this single board configuration is, that it can be produced and tested automatically and as a whole. No further assembly is necessary after testing, reducing the failure rate.



You can find more information about the used technology on page 8 & 9; an introduction to product development, production and testing can be found on page 10 & 11.

4 Solar and grid connections can be made in two ways.



Easy installation: plugs or glands, just as you prefer it (QS3200).

Either you use glands and the spring terminals on the main board directly, or you use a connector solution, just as you prefer.

The Sunmaster QS inverters can be supplied with Multi Contact material for the solar connections and euro plug connectors for the grid connection.



5 The front panel of the connection compartment can easily be replaced with a version with the integrated QS display.



6 This display is connected to the QS Communication Module, that can be inserted directly in a socket on the main board inside the cabinet. This QS Communication Module also provides the connections to the QS Data Bus for external communication. Read more about data communication, monitoring and control options on page 6 & 7.



7 The Sunmaster QS inverters are controlled by sophisticated micro-controllers and power driver circuitry. These electronics are situated on a separate board, that can be inserted into a socket on the power board. The control board is produced using SMD (Surface Mounted Devices) technology, resulting in a compact design. The control boards are the same for every Sunmaster QS inverter and can be replaced easily when necessary. The control boards can be reprogrammed with updated or customer specified settings.

8 The Sunmaster QS inverters are equipped with anti-islanding devices, that ensure the switch off in case of grid failure. The standard anti-islanding device is the QNS, based on grid voltage and frequency measurement (redundant measurement and switch off); the extended version is the VDE0126 compliant ENS unit, which adds a grid impedance measurement to the list. Both the ENS and QNS control electronics are situated on separate control boards.

QS Monitoring & Control

The intuitive approach: when you think it is possible, it is. Part of the family of QS products is an extensive program of communication, display and monitoring facilities. The central philosophy is that you literally should be able to play with the possibilities: when you think a certain configuration is possible, it is possible and easy to connect as well.

You are able to connect any type of device in any arbitrary combination in a straight forward way. From a simple local read-out of a single inverter by PC to an extensive system with multiple inverters, wireless displays, data monitoring and remote control: both are easily designed, configured and connected. Central to the concept is the QS Data Bus with the QS Multi-Master protocol, enabling bus wise connection of all devices and automatic configuration of all hardware and communication settings. All options will become available in 2002. Please check the delivery program on page 14 and 15 for availability or check with your local distributor.



1. QS Data Bus

The QS Data Bus is the heart of the communication system of the Sunmaster QS inverters. All devices are connected to this bus in a straightforward way. Each device has a bus in and bus out connection, with RJ45 (standard telephone cable) connection. Physically the bus is a standard 8 pole flat cable with a two way RS485 signal path and auxiliary power supply.

The most simple configuration is a point to point configuration, leaving the bus in connection of the first device and the bus out connection of the second device unused. The bus can be extended step by step, by connection of a new cable and device to a free bus in or out connection. The number of devices connected to a single QS Data Bus is standard 32, but can be extended to a maximum of 256.



Example of display mode of QS Link Wizard software.

2. QS Link Wizard, the QS System Management Package

The QS Link Wizard is a software package, suited for the communication with one or more QS inverters, or one or more locations, through several media. With the QS Link Wizard you can directly communicate with a Sunmaster QS inverter to monitor the data and configure its settings. Or you can use it as a full monitoring and control package to control several PV plants at different locations, with communication connections through different media: direct link, (GSM) modem connection or wireless. The QS Link Wizard shows actual

data in several displaying modes; when a QS Data Monitor is connected to the QS Data Bus, the QS Link Wizard also shows historical data in clear overviews. Data can be exported in Excell or text format.



3. QS Communication Module

The QS Communication Module is used to connect a Sunmaster QS inverter to the QS Data Bus. It can be inserted easily in the connection compartment of the inverter and has three connections: two connections for the QS Data Bus (bus in and bus out) and one connection for the optional integrated QS Display in the inverter.



4. QS Display

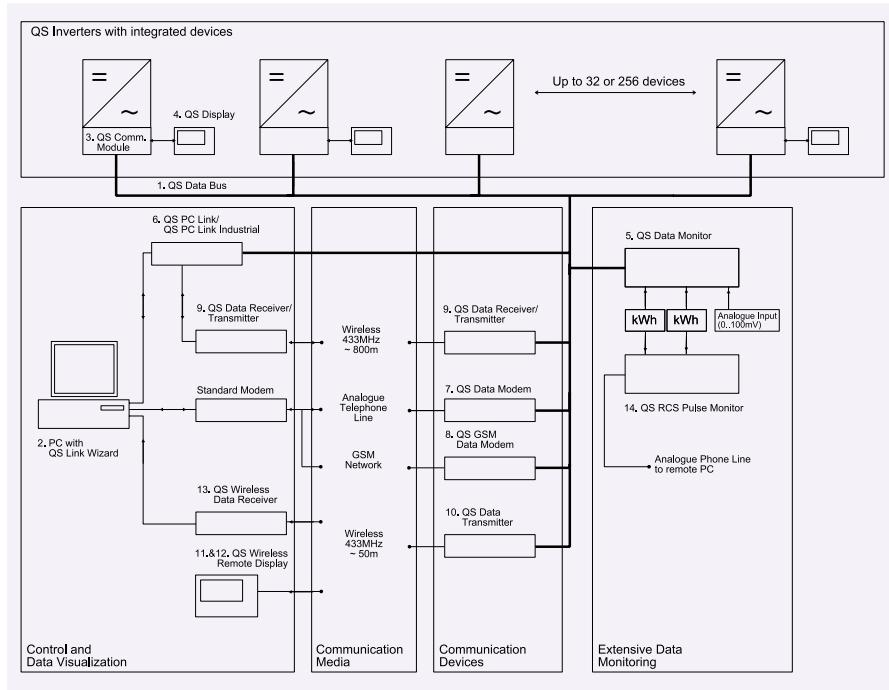
The QS Display is a display that can easily be installed in the Sunmaster QS inverters and enables the user to:

- Monitor the data from each inverter connected to the QS Data Bus: solar and grid voltage, current, frequency and power, status, total energy and operating hours and set points.
- Monitor total values of all inverters on the QS Data Bus (total power, energy, status).
- Adjust set points of the inverters connected to the QS Data Bus.

5. QS Data Monitor

The QS Data Monitor adds memory and monitoring capacity to the bus.

It scans the QS Data Bus for available devices and starts monitoring all data automatically, storing 10 minute averages.



Overview of QS monitoring & control possibilities.

The QS Data Monitor also provides means to connect and monitor max. two pulse inputs (kWh meters) and one analogue input, 0-100mV (reference cell). The data in the data monitor can be downloaded using the QS Link Wizard software on a computer connected to the QS Data Bus directly (via the PC Link) or at a remote location (via the QS Data Modem, QS GSM Data Modem or QS Data Transmitter/Receiver). The QS Data Monitor can be configured to perform automatic checks of the systems and report to a remote computer (QS Data Modem) or with sms-messages to a cellular phone (QS GSM Data Modem).

6. QS PC Link/ QS PC Link Industrial

The PC Link is used to convert the QS Data Bus into a serial connection to a PC.

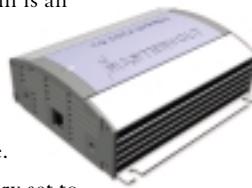


The standard QS PC Link is suited for a small network, i.e. QS Data Bus no longer than 50m, indoor installation and no more than 4 devices connected to the bus. For larger networks you need to use the QS PC Link Industrial.

Maximal QS Data Bus length in that case is 1000m and maximal no. devices is 256.

7. QS Data Modem

The QS Data Modem is an industrial modem used to connect the QS Data Bus to an analogue phone line. The modem is factory set to answer any incoming call and establish a connection with a standard modem, facilitating remote login on the QS Data Bus. The QS Data Modem has a built-in PC Link, making it possible to connect a local PC onto the QS Data Bus at the same time.



8. QS GSM Data Modem

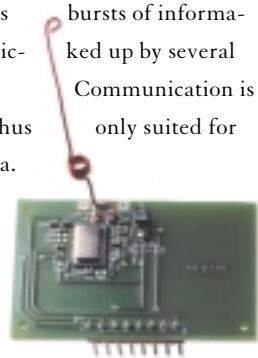
The QS GSM Data Modem is an industrial modem used to connect the QS Data Bus to a GSM network. This makes remote communication possible in places where no telephone line is available.

9. QS Data Transmitter/Receiver

The QS Data Transmitter/Receiver provides a wireless means of extending the QS Data Bus. A set of two QS Data Transmitter/Receivers behaves similar to an ordinary QS Data Bus cable, i.e. communication is bi-directional. Maximum distance that can be crossed is 800m.

10. QS Data Transmitter

The QS Data transmitter is a wireless transponder of the data that is on the QS Data Bus. It sends data that can be picked up by several wireless devices. Communication is uni-directional, thus only suited for the display of data.



11. QS Wireless Remote Display

Remote stand alone display that displays the data sent by the QS Data Transmitter connected to the QS Data Bus. When a QS Data Monitor is connected to the QS Data Bus, also historical data can be displayed.

12. QS Wireless Remote Display Large

Large info display showing basic data, sent by the QS Data Transmitter.

13. QS Wireless Data Receiver

PC connector for the wireless receipt of data from the QS Data Bus. Basic data can be displayed using the QS Link Wizard package.

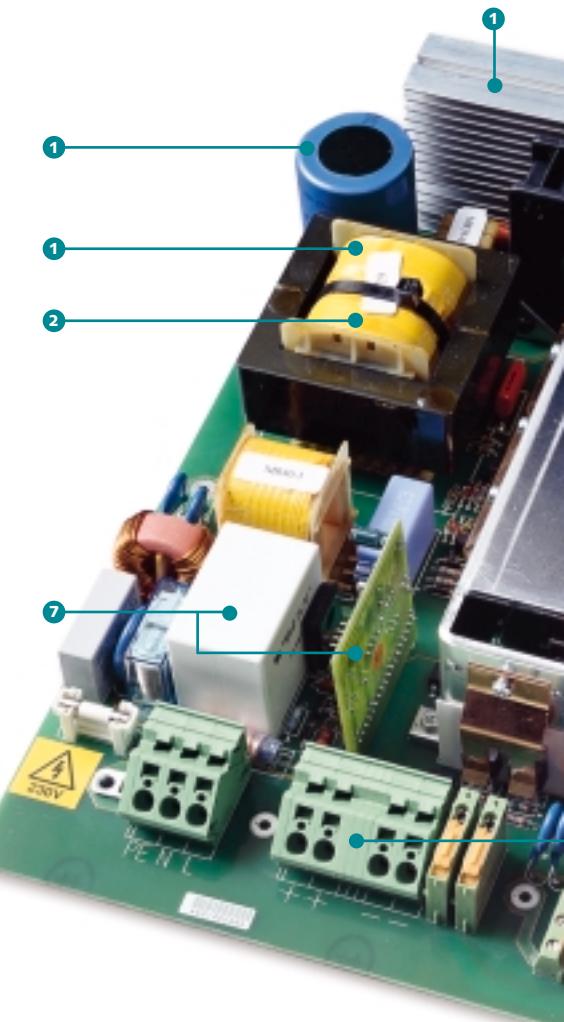
14. QS RCS Pulse Monitor



Basic data monitor for the monitoring of up to 5 pulse inputs (kWh meters). The built-in modem can be configured to send the data automatically by phone line at programmable intervals (i.e. daily, weekly, etc.). Data is stored in daily, weekly and monthly totals. A separate remote software and configuration package is included.

Advanced technology

With each Sunmaster QS you buy, you buy an inverter, designed, produced and tested to last for an extended period of time. High frequent Mosfet technology combined with high frequent Class II safety transformers, provide safe, efficient and lasting power conversion in a compact, low weight enclosure. Typical Mastervolt novelties, such as QNS redundant grid monitoring, multiple Solar MPPT inputs, solar earth fault detection and the transparent extensive monitoring options, including wireless communication, give you the tools to provide a solution to every wish you might have.



① High frequency fly back power converter

This converter is the heart of all Sunmaster QS inverters. It is used as a basic building block to build the whole range: two of these converters are in the QS1200 and QS2000, four in the QS3200 and six in the QS5000. The converter is built from efficient high frequent power Mosfets, high voltage capacitors and two high frequent Class II safety transformers. The converter converts the solar DC voltage into a pure sine wave with a suitable peak voltage and frequency, matching the grid characteristics. The high frequent switching (25,000 times per second) enables the clear build up of a well defined sine, resulting in an extremely low harmonic distortion at the grid side (THD<<3% in compliance with IEEEp929).

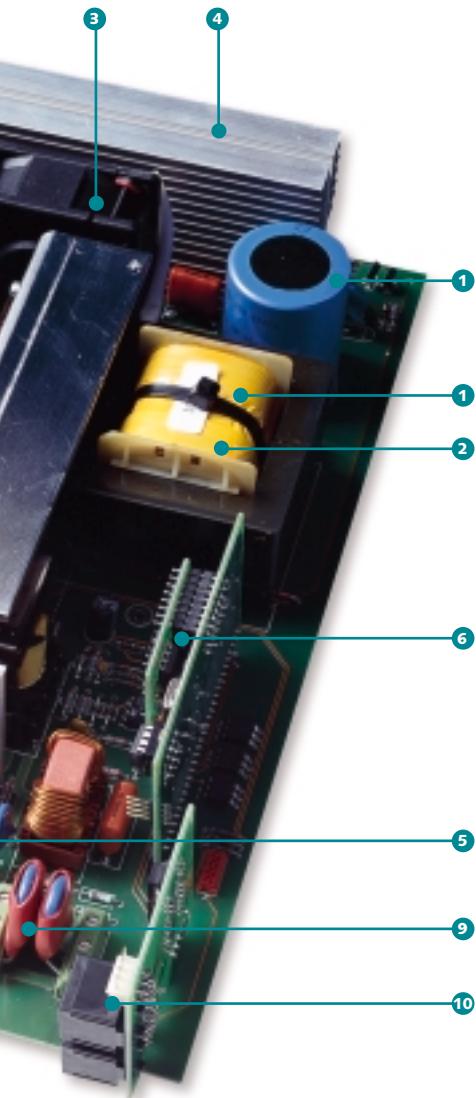
② High frequent Class II safety transformers

These transformers not only convert the full power but also provide the galvanic separation between grid and solar side of the inverter. Galvanic separation means that the grid and solar side are not electrically connected, providing a very high level of safety: in case of failure, there is no possible way, in which the grid voltage might be passed onto the solar side and vice versa. The power is transported from solar to grid side using electro-magnetic coupling inside the transformers, which is only present when the QS operates properly. High frequent switching technology makes it possible to use the transformers in a very efficient way. The same power is transported through a much smaller high frequent transformer (weight & size ten times less) than would be possible using conventional

low frequent technology. This explains the fact that the QS products are so very compact and low weight. The additional advantage is that the whole unit is assembled on one single board. This makes assembly more easy (less faults) and makes complete *in circuit* and functional testing possible.

③ Temperature controlled derating

The QS inverters are able to convert more power than their nominal specified power for certain periods of time. In principle this power is only limited by the amount of heat production in the inverter. Excess heat is first removed from the cabinet by forced cooling by the low energy, temperature controlled fan. When this is not enough, the power from the array is reduced by a slight increase of the DC voltage, moving the DC voltage away from the MPPT



point of the array.

④ Static MPPTacker

Typical for the Mastervolt products is the simple but stable and reliable MPPTacker algorithm. The characteristics of a PV array exhibit a strong dependency on irradiation, temperature, cell type, shading, cell defects or mismatch. Especially at start up (low irradiation) and strongly fluctuating circumstances (cloudy days), dynamic trackers might show instable and inefficient behaviour. Mastervolt solved this by implementing a static MPPTacker, that calculates the MPP set point from the measured open circuit voltage of the array (every two seconds). The open circuit voltage of the array is well defined under all circumstances, so the inverter can always set a stable MPP set point, resulting in stable and reliable operation.

⑤ Multiple Solar inputs with multiple MPPTackers

The QS3200 & 5000 are equipped with resp. two and three MPPTacked solar inputs. This makes it possible to connect strings with different number of modules in series, different orientations or different module types. With this feature you can connect virtually any number of modules or any array configuration to the QS inverters. If necessary the QS3200 and QS5000 can also be configured to have one single input.

⑥ Intelligent control

The QS inverters are controlled by the central processor on the control board. The processor controls the Mosfets and IGBTs in the input and output converters through dedicated PWM chips, MPPTacker control, self diagnostics and communication with the LED bar, QS Display and QS Data Bus.

⑦ QNS/ENS redundant grid monitoring

The presence of the grid is detected using redundant measurement of grid voltage and frequency (QNS). Redundant means that two independent measuring circuits and micro-controllers measure the grid voltage and frequency independently.

When one circuit fails, the remaining circuit will still do the job. In case of grid failure the inverter is switched off in the same redundant way: by a double pole mechanical relay and by means of the solid state switches (Mosfet and IGBT) on the grid side of the inverter. The ENS versions of the grid monitoring add the measurement of the grid impedance to the list. The grid impedance is measured using a capacitor that is switched in parallel to the grid for one cycle. During this cycle the capacitor draws and feeds back a certain amount of 'blind' current. This amount of current is a measure for the grid impedance. This technology uses little power and has no influence on the harmonic behaviour on the grid side. The measurement protocol incorporates features to deal with interference of several ENS units performing measurements on the same grid.



The switch off impedance level can be set by a jumper (0,5 or 1 Ω).

⑧ Earth fault detection

The Solar array works with high DC voltages in a 'floating' configuration. This means that none of the solar connections are grounded. In such systems, the first ground connection is not dangerous, since it carries no current (no closed loop). The second earth connection however closes the loop through ground and can be dangerous. The QS inverters are equipped with earth fault detection, detecting the first ground fault, switching the inverter off. It is indicated to the user that the system has become potentially dangerous (i.e. when a second earth fault is created) and the system should be checked (indication in the LED Bar).

⑨ Thermally guarded lightning varistors

To protect the inverter from lightning induced voltage spikes, both solar and grid connections are protected by varistors. The proper operation of the varistors is checked by continuous monitoring of the temperature. Possible failure of these varistors is indicated to the user through the LED bar indicator. These varistors are located in the connection compartment for easy replacement in case of failure.

⑩ Communication interface

All communications of the QS range are based on the RS485 QS Data Bus. This means that it is possible to connect one or several units with one or several options, such as display(s), computer(s), datamonitor(s) or other devices in a straight forward way. You just extend the QS Data Bus to the new unit or option and connect it. The protocol solves all configuration and communication issues. A Sunmaster QS unit is connected to the QS Data Bus using a simple plug-in communication interface, which is also used for the communication with the integrated display. More information on the extensive communication scheme can be found on pages 6 and 7.

Product development, production & quality control: a joint effort!

In the last decade Mastervolt has been investing heavily in the professionalism, structure and philosophy behind its product development and co-operation with producing partners. How this has resulted in a key philosophy for product development, co-operation and set-up of the testing protocols is presented here.

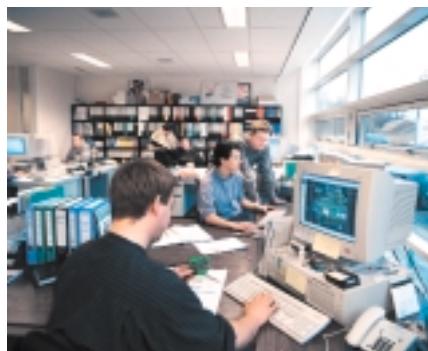


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Product Development: taking pride in new innovations and high quality

Product development within Mastervolt is carried out by highly skilled engineers working on the new QS series of products and accessories. To ensure high quality designs and the optimal development of knowledge, the engineering group defined a key philosophy:

- The only way to get a high quality product is to go through the whole development process step by step. Mastervolt works with **standardised procedures** with pre-described design steps and evaluation procedures.



*Technology is fun!
Our product engineers at work.*

- **Knowledge is everything.**

Our designs are built using state-of-the-art technologies, design tools and testing facilities. You can not stay in touch with new developments when working on an island. Mastervolt works together with several design partners, specialists (power electronics and control electronics) and accredited test institutes to optimise designs and the knowledge base of the group.

- **Evaluation and testing of prototype products** is a critical part of the development process. Most tests can be performed in house (performance testing, functional testing, EMC, Harmonics and field test at our own array). Some tests, however, are performed in co-operation with external test institutes (ECN, KEMA, Fraunhofer, etc.). These tests concern compliance testing, strain testing and extensive performance testing. Investments in testing equipment and external testing are crucial to the quality of our product and has the continuous attention of the group.

- **Technology is fun!**

The innovative power of the engineering department is essential to our success in the market. On the one hand our engineers closely monitor the requests from the market, while on the other hand there is also plenty of room to explore and develop new innovations. We mention the high frequent power concept, multiple MPPTtrackers in the QS3200 and QS5000 and the smart Soladin 120 inverter concept as results from this innovative power.



The Sunmaster QS series is manufactured using the most modern production techniques.

- Participation in several international **product development projects** enables us to follow international trends, innovations and markets.
- Engineering of product ideas towards full grown industrial products, does not only require sound conceptual, electrical and embedded software engineering, but also fast knowledge and experience with production techniques. The quality of a product is strongly determined by the way it is produced: a good design deals with possible problems during production in advance; during the engineering stage. **Co-development** with our production partners is crucial in this respect.

Production: a joint effort

All Mastervolt products are produced in close partnership with dedicated production companies. All these companies are ISO9001 certified and selected on basis of their experience with state-of-the-art technologies and their capacity to work together with our research and engineering department on the engineering of our products. As explained, co-development with our production partners is crucial to get a high quality design. In a joint effort, design of the products is optimised, production lines and test facilities are set up, before production starts. The Sunmaster QS products consist of power or main boards, with all power electronics, and several control boards, with microprocessors and control electronics. They are assembled at different production lines using different production methods. The main boards are produced on insert machines for the small components and hand-insert lines for larger components (transformers, capacitors, etc.). The control boards are produced using the fast and compact SMD (Surface Mounted Devices) technology.



Burn in testing for 24 hours at 50°C ambient.

Quality Control

The quality of our products is guarded during three stages:

- During product development: evaluation and testing of the prototype products.
- During the last development stages and production start-up: co-development with our producing partners.
- Production: testing protocol for each unit under production.

The test protocol during production is depicted in the scheme shown here.

Visual inspection

When all boards arrive from the production lines, they are visually inspected for incorrect inserts, physical damage of the components and soldering errors.

In Circuit Testing (ICT)

During the ICTTesting, the boards are placed on a needle bed. The needles from the needle bed contact certain points in the circuitry. The ICTTesting is first used to test individual components and parts of the circuitry. But, since the whole power conversion, including transformers, is on one board, the ICTTest can also be used for a partial functional test. This is one of the benefits of the HF power technology with small transformers that are mounted on the actual board. The ICTTest is automated and produces a report of all individual measurements. The ICTTest is the most detailed testing method available and is the most crucial test in the whole program.

Programming and functional testing

The microprocessors on the control board are programmed on the ICTTester. After this, their input/output behaviour is tested on a separate functional tester.

Anti-Moisture Coating

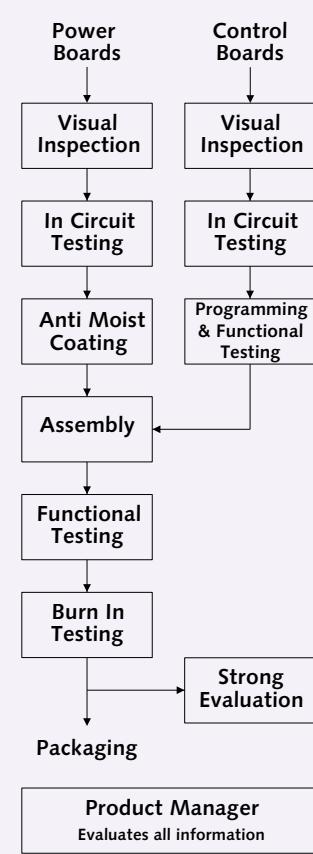
The power board contains high voltage DC parts that are sensitive to moisture. Therefore all power boards of the Sunmaster QS inverters are treated with a special anti-moisture coating (so-called 'humi-sealing').

Functional Testing

After the assembly of the control boards on the power board, the unit is complete. The complete unit is functionally tested, which means that its main input/output behaviour is verified. Input power and current are measured as a function of the input voltage, to verify the input characteristics. DC input is compared to the AC output to calculate and verify efficiency. Harmonic behaviour and anti-islanding is tested and verified.

Burn-in Testing

Typical to electronics is that for newly produced units the chance on failure is the highest by far within the first hours of operation. After this the failure rate is very low and increases again when



the life time of the unit has expired (typically after 15 years for Mastervolt products). The higher failure rate in the first few hours is explained by the fact that some components might have material defects, that only show up when they operate at full load (i.e. not during functional or ICTTesting). The Burn-in Testing is used to solve this problem: the units are tested for 24 hours at full load and at higher ambient temperatures (40-50°C), to literally burn out all component defects, that still might be present in the product. The result is a thoroughly tested product with a very low failure rate.

Strong Evaluation

One out of every 50 units is tested extensively in our own laboratory. All production testing is repeated and extended with even more detailed testing of components and electrical behaviour. This is to verify whether production is still within its tolerance limits and of constant quality. The strong evaluation is also used to verify the effectiveness of all production tests.

Solar Product Manager

Information exchange between all processes in the organisation is crucial to improve quality and design. The communication between engineering, service and production is co-ordinated by a dedicated Solar Product Manager. The Product Manager collects all test results from production and strong evaluation testing, assesses service problems and feeds this information back into the engineering and production process.

General

Model	Sunmaster QS 1200	QS 2000	QS 3200	QS 5000
Typical string length	5-9 72 cells modules or 10-18 36 cells modules			
Operating temperature	0°C to 50°C			
Storage temperature	-20°C to 70°C			
Relative humidity	max. 95%; PCB has anti-moisture coating			
Protection degree	IP23			
Noise level	<30 dBA			
Safety class	class I			
Galvanic isolation	class II			
Dimensions	330x220x111 mm	330x300x111 mm	435x318x144 mm	600x318x170 mm
Weight	4.4 kg	6 kg	10 kg	13 kg

Solar input (DC)

Nominal power	850W DC@40°C	1500W DC@40°C	2500W DC@40°C	3750W DC@40°C
PV power range	700-1200 Wp	1200-2000 Wp	2000-3400 Wp	3400-5000 Wp
MPP Tracker	1 MPP Tracker		2 MPP Trackers	3 MPP Trackers
MPP voltage range	100-380V DC; p-, m- and a-Si			
Maximum voltage	450V DC			
Nom. rated current@40°C	5A	7.5A	2x 7.5A or 1x15A*	3x 7.5A or 1x 22.5A*
Start-up power	2W, power drawn from the solar side	2W, power drawn from the solar side	4W, power drawn from the solar side	5W, power drawn from the solar side
String connections	2	2	2x2 or 1x4*	3x2 or 1x6*
DC connector	glands + PCB spring terminals 4 mm ² max. or Multi Contact connectors, depending on the model			

Grid output (AC)

Voltage	230V (window settings and reclosure time depend on model, please refer to the delivery program on page 14 & 15)			
Current (fused)	6.3A	10A	16A	25A
Frequency	50 Hz (window settings and reclosure time depend on model, please refer to the delivery program on page 14 & 15)			
Power factor	0.99			
THD	< 3% @ rated load; in compliance with IEEE p929			
Stand-by power	0W (DC voltage controlled relais)			
European efficiency	92%	92%	93%	93%
Maximum efficiency	93%	93%	94%	94%
AC connector	gland with PCB spring terminals; Europlug connector optional			

Safety devices

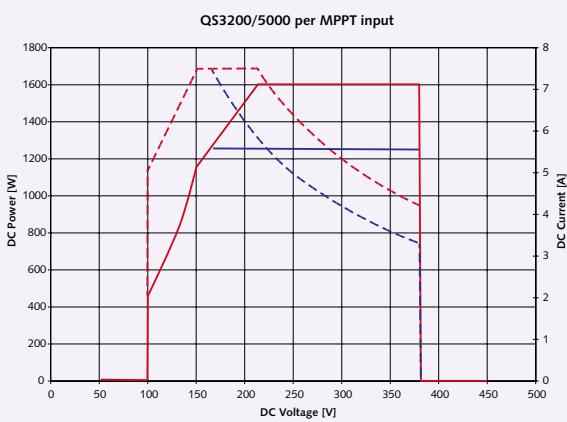
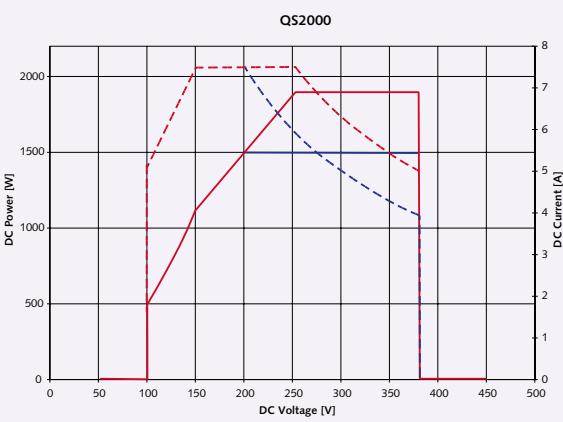
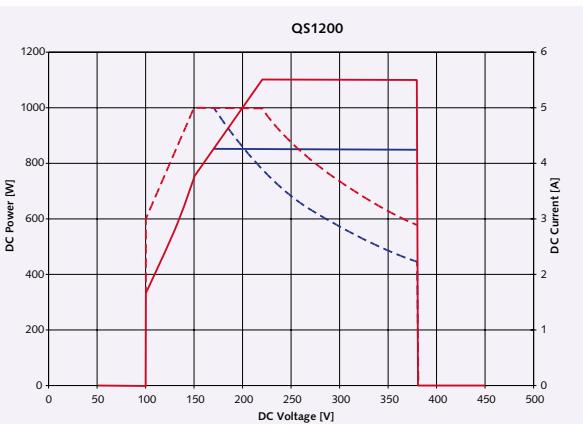
General	galvanic separation between DC and AC side, by means of a class II HF transformer
Island protection	redundant voltage and frequency window monitoring (QNS); redundant switch off (independent control of 2 pole relais and solid state switch); or ENS (VDE0126 compliant), depending on the model
Temperature protection	power derating at higher ambient temperatures; switch off at 80°C inverter temperature
DC side	earth fault detection; over voltage, over current, transients (therm. guarded varistors), over power (temp. controlled derating), reverse polarity protected
AC side	over current (fuses), transients (varistors)

Compliance

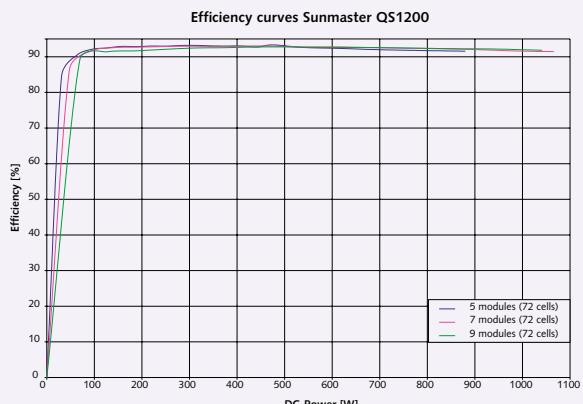
CE/KEMA approval	yes/pending
EMC directive	EMC 89/336/EEG
Emission	EN 50081-1, EN 55014, EN 55022, VDE 0871 class B
Harmonics	EN 61000-3-2, IEEEp929
Immunity	EN 50082-2
LV directive	LV 73/23/EEC
Electric safety	EN 60950 / KEMA approval pending

Monitoring

Indicator	6 LEDS for indication of power and fault diagnosis
External communication	insert module for RS485 communication with the QS Data Bus (refer to page 6 & 7)
Available data	UDC; IDC; PDC; UAC; IAC; PAC; FAC; temp; EAC (kWh: class II); total operating hours; status with fault indication
Available set points	MPPT Tracker settings; QS Data Bus ID; U/F window settings; reset EAC counter
Monitoring devices	The QS products can be linked using the QS Data Bus and connected to an extensive range of communication devices, facilitating direct or remote communication through a telephone line, GSM network or wireless transmissions. Display facilities and data monitoring capabilities (including external pulse inputs and analogue signals) are included in the program. Please refer to page 6 & 7 for more information and to page 14 & 15 for the availability.



— Rated DC power @40°C
— Max. DC power
- - - Rated DC current @40°C
- - - Max. DC current



Designing your PV system

As can be seen from the specifications, the QS series offers a full range of products for systems from 700 to 5000Wp. The solar input window is wide (typically 5-9 72 cell modules in series per string) and design flexibility is optimal because of the multiple solar inputs for the QS3200 and QS5000. The multiple solar inputs enable you to design a system with virtually any number of modules, with different strings lengths or orientations, without loss of yield due to mismatch. To guide you through this wide variety of options we provide the *PV Design Wizard*, that will be available at our website from the end of 2001 onwards.



The graphs on this page show the typical DC power and current behaviour vs. the DC voltage for the QS1200, QS2000 and for each input of the QS3200 (two inputs*) and QS5000 (three inputs*).

We distinguish:

- The rated current and power at 40°C: this is the maximum power and current that can be converted continuously at an ambient temperature of 40°C. At lower ambient temperatures the rated current and power are higher.
- The maximum power and current: these are the limits at which the current and power are limited by the control software to prevent damage. The maximum current and power level can typically be maintained for 10 to 15 minutes. After this time the inverter will derate the DC power depending on inverter temperature, eventually to the level of the rated power and current.

When determining the number of modules per string and number of strings per input, please check the following:

(example: 1 string of 9 modules (120Wp, Umpp: 33V; Uoc: 42V; Impp:3.6A) connected to the QS1200)

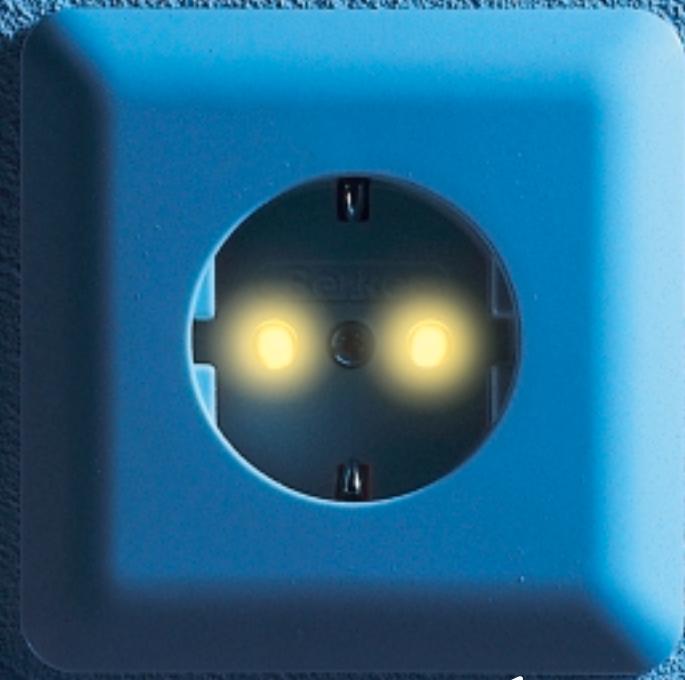
Methodology	Example
1. Determine the amount of overdimensioning of the system you allow, i.e. how much bigger is the PV array (in Wp) allowed to be in respect to the rated power of the inverter (in W). This factor is typically somewhere between 1,2 and 1,33.	1,3
2. The open circuit voltage (Voc) at STC per module multiplied by the number of modules in series should be higher than 200VDC and lower than 390VDC.	9 x 42 = 378 Ok
3. When you are connecting more strings, the string length of strings connected to the same input, should be equal.	Ok
4. When you have determined the number of modules per string, determine the maximum power point voltage (Umpp) at STC per string: Umpp per module, multiplied by the number of modules in series. Look in the graph of the QS inverter you are going to use and determine the rated current at this Umpp.	9 x 33 = 297V → ~ 2,8A
5. The total maximum power point current (Impp) you can connect to an input should not exceed the rated current (see 3.) multiplied by the overdimensioning factor you allow (see 1.).	2,8 x 1,3 = 3,64 > 3,6 → OK

* Important: as can be seen from the specifications, the QS3200 and QS5000 can be configured to have two respectively three inputs or to have one single input. The characteristics of this single input configuration are similar to the characteristics per input, but with power and current numbers multiplied by two (QS3200) or three (QS5000).

Delivery program QS Range

article no.	product group	name	model description
		Sunmaster QS QNS p/m-Si	
13-03-01200	SB	Sunmaster QS 1200 QNS p/m-Si	<i>AC Side: 207-253VAC; 49.8-50.2Hz.</i>
13-03-02000	SC	Sunmaster QS 2000 QNS p/m-Si	<i>Anti islanding: QNS; reclosure time 60s.</i>
13-03-03200	SD	Sunmaster QS 3200 QNS p/m-Si	<i>Module type: poly and mono crystalline.</i>
13-03-05000	SE	Sunmaster QS 5000 QNS p/m-Si	<i>AC/DC connection: glands with PCB connectors.</i>
		Sunmaster QS ENS p/m-Si	
13-03-11200	SB	Sunmaster QS 1200 ENS p/m-Si	<i>AC Side: 196-253VAC; 49.8-50.2Hz.</i>
13-03-12000	SC	Sunmaster QS 2000 ENS p/m-Si	<i>Anti islanding: ENS; reclosure time 10s.</i>
13-03-13200	SD	Sunmaster QS 3200 ENS p/m-Si	<i>Module type: poly and mono crystalline.</i>
13-03-15000	SE	Sunmaster QS 5000 ENS p/m-Si	<i>AC/DC connection: glands (AC); MultiContact (DC), glands are included separately.</i>
		Sunmaster QS It QNS p/m-Si	
13-03-31200	SB	Sunmaster QS 1200 It QNS p/m-Si	<i>AC Side: 184-276VAC; 49.7-50.3Hz.</i>
13-03-32000	SC	Sunmaster QS 2000 It QNS p/m-Si	<i>Anti islanding: QNS; reclosure time 300s.</i>
13-03-33200	SD	Sunmaster QS 3200 It QNS p/m-Si	<i>Module type: poly and mono crystalline.</i>
13-03-35000	SE	Sunmaster QS 5000 It QNS p/m-Si	<i>AC/DC connection: glands with PCB connectors.</i>
		Sunmaster QS QNS a-Si	
13-03-01201	SB	Sunmaster QS 1200 QNS a-Si	<i>AC Side: 207-253VAC; 49.8-50.2Hz.</i>
13-03-02001	SC	Sunmaster QS 2000 QNS a-Si	<i>Anti islanding: QNS; reclosure time 60s.</i>
13-03-03201	SD	Sunmaster QS 3200 QNS a-Si	<i>Module type: amorphous.</i>
13-03-05001	SE	Sunmaster QS 5000 QNS a-Si	<i>AC/DC connection: glands with PCB connectors.</i>
		Sunmaster QS ENS a-Si	
13-03-11201	SB	Sunmaster QS 1200 ENS a-Si	<i>AC Side: 196-253VAC; 49.8-50.2Hz.</i>
13-03-12001	SC	Sunmaster QS 2000 ENS a-Si	<i>Anti islanding: ENS; reclosure time 10s.</i>
13-03-13201	SD	Sunmaster QS 3200 ENS a-Si	<i>Module type: amorphous.</i>
13-03-15001	SE	Sunmaster QS 5000 ENS a-Si	<i>AC/DC connection: glands (AC); MultiContact (DC), glands are included separately.</i>
		Sunmaster QS It QNS a-Si	
13-03-31201	SB	Sunmaster QS 1200 It QNS a-Si	<i>AC Side: 184-276VAC; 49.7-50.3Hz.</i>
13-03-32001	SC	Sunmaster QS 2000 It QNS a-Si	<i>Anti islanding: QNS; reclosure time 300s.</i>
13-03-33201	SD	Sunmaster QS 3200 It QNS a-Si	<i>Module type: amorphous.</i>
13-03-35001	SE	Sunmaster QS 5000 It QNS a-Si	<i>AC/DC connection: glands with PCB connectors.</i>
		Dummy models	
13-00-80010	SX	Sunmaster QS 1200 Dummy	
13-00-80020	SX	Sunmaster QS 2000 Dummy	
13-00-80030	SX	Sunmaster QS 3200 Dummy	
13-00-80040	SX	Sunmaster QS 5000 Dummy	

article no.	product group	name	model description
		Connectivity	
13-03-51200	SN	Multi Contact DC connector set QS 1200/2000 (2 strings)	<i>Add on Multi Contact connector set with cable and sealing caps</i>
13-03-53200	SN	Multi Contact DC connector set QS 3200 (4 strings)	
13-03-55000	SN	Multi Contact DC connector set QS 5000 (6 strings)	
13-03-41200	SO	Euro plug AC connector set QS 1200	<i>Add on Euro Plug AC connector set with cable</i>
13-03-42000	SO	Euro plug AC connector set QS 2000	
13-03-43200	SO	Euro plug AC connector set QS 3200	
13-03-45000	SO	Euro plug AC connector set QS 5000	
		Communication & monitoring	
13-03-90485	SP	QS RS485 Communication Module	<i>Insert print for the QS powerboard, connection to QS Data Bus and QS display</i>
13-03-91000	SN	QS Data Modem	<i>Modem for connection QS Data Bus to phoneline</i>
13-03-91001	SN	QS GSM Data Modem	<i>Modem for connection QS Data Bus to GSM network</i>
13-03-91005	SN	QS Data Monitor	<i>Extended datalogging capacity for QS Data Bus</i>
13-03-91010	SR	QS PC Link	<i>Connection of a small QS Data Bus network to a PC</i>
13-03-91020	SN	QS PC Link Industrial	<i>Connection of a large QS Data Bus network to a PC</i>
13-03-91030	SR	QS Data Transmitter	<i>Unidirectional wireless data transmitter for QS Data Bus</i>
13-03-91040	SR	QS Data Receiver	<i>Unidirectional wireless data receiver for QS Data Bus</i>
13-03-91050	SN	QS Data Receiver/Transmitter	<i>Bi-directional wireless extension of the QS Data Bus</i>
13-03-93000	SN	QS RCS Modem	<i>Stand alone modem with programmable pulse input counter</i>
13-03-92000	SZ	QS Link Wizard	<i>The QS systems management software package</i>
13-03-61200	SF	QS Display QS 1200	<i>Add on display in the inverter; interacts with QS Data Bus</i>
13-03-62000	SF	QS Display QS 2000	
13-03-63200	SF	QS Display QS 3200	
13-03-65000	SF	QS Display QS 5000	
13-03-70000	SG	QS Wireless Remote Display small	<i>Remote display with wireless unidirect. link to QS Data Bus</i>
R13-03-70010	SG	QS Wireless Remote Display large	
13-00-10905	SO	QS Data Bus 0.5m	<i>QS Data Bus 8 pole flat cable with RJ45 connectors</i>
13-00-10906	SO	QS Data Bus 6m	
13-00-10910	SO	QS Data Bus 10m	
13-00-10915	SO	QS Data Bus 15m	
65-02-300520	SO	QS Data Bus cable 100m	<i>QS Data Bus 8 pole flat cable</i>
64-08-602600	SO	RJ45 connectors 100p	<i>QS Data Bus connectors</i>
65-02-300530	SO	RJ45 Crimping Tool	<i>QS Data Bus connector crimping tool</i>



Connect to the sun.



Sunmaster QS series

- advanced HF power concept
- fast and safe installation
- broad Vdc window
- 700 - 5000 Wp solar power

Mastervolt Solar offers a powerful combination of premium quality, ongoing innovation and inherent reliability. We develop and produce grid connected inverters from 100W to 25 kW, according to the most stringent international regulations. Mastervolt Solar inverters are all backed up by excellent service and support.

